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Modeling Tracheal Occlusion in the Embryonic Lung

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Abstract

Prenatal tracheal occlusion has different effects on a developing lung and depends on the stage of development. It enhances lung growth when performed in near-term fetus. Laboratory experiments have shown that tracheal occlusion of the embryonic lung increases the rate of lung branching by 2-to 3-fold in mouse models. Tracheal occlusion leads to retention of fluid in the lung and increases the pressure in the lumen. The mechanism by which tracheal occlusion accelerates lung branching is not fully understood. In order to study the effects of increased lumen pressure and fluid retention on lung branching, we develop a linear elastic model and a solute transport model in a three-dimensional lung geometry. The finite element method is used to obtain numerical solutions. Results from numerical simulations show that blocking the outflow of fluid may alter the distribution patterns of morphogen transport and binding thus, increasing the number of locations at which branches are induced.